

**2815/06**



Candidate Forename	Candidate Surname
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Centre Number						Candidate Number				
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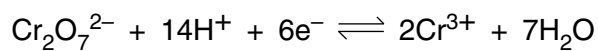
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **45**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	8	
2	6	
3	14	
4	6	
5	11	
TOTAL	45	

Answer **all** the questions.

- 1** A student wanted to measure the standard electrode potential of:



- (a) (i)** What is the oxidation number of Cr in the  $\text{Cr}_2\text{O}_7^{2-}$  ion?

..... **[1]**

- (ii)** Draw a labelled diagram of the apparatus he could use. State the conditions required.

**[5]**

- (b) The standard electrode potential of the  $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$  half-cell is +1.33V.

The solution in the student's half-cell contained  $1\text{ mol dm}^{-3}$   $\text{Cr}^{3+}$  and  $\text{H}^+$  but less than  $1\text{ mol dm}^{-3}$   $\text{Cr}_2\text{O}_7^{2-}$ .

Would the student's measured value be higher, lower or the same as the standard electrode potential?

Explain your answer.

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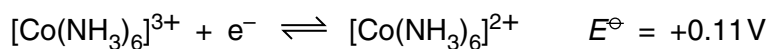
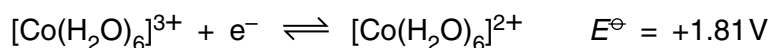
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..... [2]

[Total: 8]

- 2 The following standard electrode potential data refers to different reactions involving cobalt complexes in the +2 and +3 oxidation states.



- (a) Which cobalt complex is the strongest oxidising agent? Explain your answer.

.....  
 .....  
 .....  
 ..... [3]

- (b) What is the colour of  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ?

..... [1]

- (c)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  ions may be reduced to  $[\text{Co}(\text{NH}_3)_6]^{2+}$  by metallic iron, which is oxidised to  $\text{Fe}^{2+}$ .



Write a balanced chemical equation for this reaction and show that the reaction is feasible.

.....  
 .....  
 .....  
 ..... [2]

[Total: 6]

3 In its ions or compounds, copper exists in two main oxidation states,  $\text{Cu}^+$  and  $\text{Cu}^{2+}$ .

(a) (i) Complete the electron configuration for a  $\text{Cu}^+$  ion.

$1s^2 2s^2 2p^6$  ..... [1]

(ii) Use your electron configuration to explain why  $\text{Cu}^+$  ions are **not** coloured.

.....  
.....  
..... [2]

(b) The  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  complex is blue but the  $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$  complex is dark blue. Explain why different ligands give different colours.

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..... [3]

(c) When copper(I) chloride is added to water it forms a blue-green solution and a reddish-pink solid.

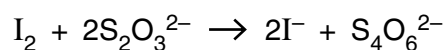
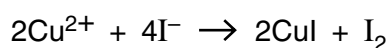
Explain these observations and write an equation for the reaction occurring.

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..... [3]

(d) Copper is widely used to make alloys such as brass. The % of copper in a sample of brass can be determined by titration.

- 1.65 g of brass were reacted with nitric acid and the resulting solution was neutralised and made up to 250 cm<sup>3</sup> in a standard flask;
- Excess KI was added to 25.0 cm<sup>3</sup> of this solution;
- The resulting solution required 19.80 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution to react with the iodine produced.

The equations for the reactions involved are;



Determine the % of copper in the sample of brass.

% copper in sample ..... % [5]

**[Total: 14]**

4 The complex ion,  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  shows a form of stereoisomerism.

(a) What type of stereoisomerism does  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$  show?

..... [1]

(b) Draw 3-D diagrams to show the two isomers of  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ .

[2]

(c) The complex ion  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$  shows a different type of stereoisomerism.

Name this type of stereoisomerism and draw 3-D diagrams of the two isomers.

name of type of stereoisomerism ..... [1]

[2]

[Total: 6]

- 5 In this question, one mark is available for the quality of use and organisation of scientific terms.

Transition metal complexes typically show four-fold and six-fold co-ordination.

Using suitable examples:

- State what is meant by co-ordination number;
- Discuss the possible shapes and bond angles of four and six co-ordinated complexes;
- Show how ligand exchange can result in a change in the co-ordination number, shape and charge of a complex ion.

Diagrams and equations should be used to illustrate your answer.

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**[10]**

**[Total: 11]**

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